MISSION OPERATIONS DIRECTORATE
FLIGHT DIRECTOR OFFICE

STS-100/6A MISSION SUMMARY

FLIGHT READINESS REVIEW

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STS-100/6A Shuttle Overview

- **OV-105 – Endeavour**
- **Crew – 6 US, 1 Russian**
  (No crew exchange)
- **Mission Duration 11+1+2**
- **7 N2 tanks**
- **5 Cryo Tanks sets**
  - **Cryo margins positive for 11+1+2 mission with ~101 hours pad hold, H2 limited.**
- **Two Planned EVAs, One unscheduled EVA**
- **Propellant acceptable. Fwd ~ 700 #, Aft ~ 3000# margin**
- **Shuttle reboost planned, to be performed from these margins**

STS-100/6A Mission Summary

- **Four primary objectives for STS-100, in priority order:**
  - **1.) SSRMS Delivery and checkout**
    - **EVA Deployment and power connection/transfer**
    - **Critical path for airlock delivery on 7A**
  - **2.) Delivery of critical consumable supplies from MPLM**
  - **3.) Outfit US Lab with Express Racks and transfer Utilization Experiments**
    - **2 Express racks**
    - **Resupply Stowage Racks, Resupply Stowage Platforms**
    - **Four powered payloads carried in shuttle middeck**
  - **4.) Delivery of on-orbit spares**
    - **DC Switching Unit (DCSU)**
    - **Video Signal Conditioner (VSC)**

STS-100/6A Critical Activities

To preserve the assembly sequence, 6A must achieve minimum functionality for the SSRMS to allow airlock placement on 7A

Activities required:

- **Rendezvous/dock**
- **Transfer SLP to Lab and deploy SSRMS via EVA**
- **'Walkoff' SSRMS onto Lab PDGF**
- **Transfer power from SLP to Lab PDGF***
  - **Possible to do on Expedition EVA**
- **Berth MPLM and remove/install (critical) cargo**
- **Remove MPLM**

**This mission would require a minimum of 6 days (3 docked)**

6A Mission Overview

- **FD1**
  - **Launch**

- **FD2**
  - **Activate and checkout OIUs**
  - **SRMS Checkout**
  - **EMU checkout**
  - **Activate and checkout Orbiter Docking System**
  - **OSVS Checkout**
 - **Orbiter Cabin depress to 10.2 psi**

6A Mission Overview

- **FD3**
  - **Activate APCUs**
  - **ISS Maneuver to Docking Attitude**
  - **ISS Feather Solar Arrays for Docking (P6, FGB, SM)**
  - **Perform +Vbar ISS rendezvous**
  - **Dock Orbiter to PMA2**
  - **Exchange key items via PMA2 (No Ingress)**
    - **To ISS:**
      - **RWS UOP Bypass Cables**
      - **Video Crosswire Cables**
      - **PCS Software Upgrade CD**
      - **CWC's, IMAX Film, ODF**
    - **From ISS:**
      - **Spare PGT For EVA**

6A Docking to ISS
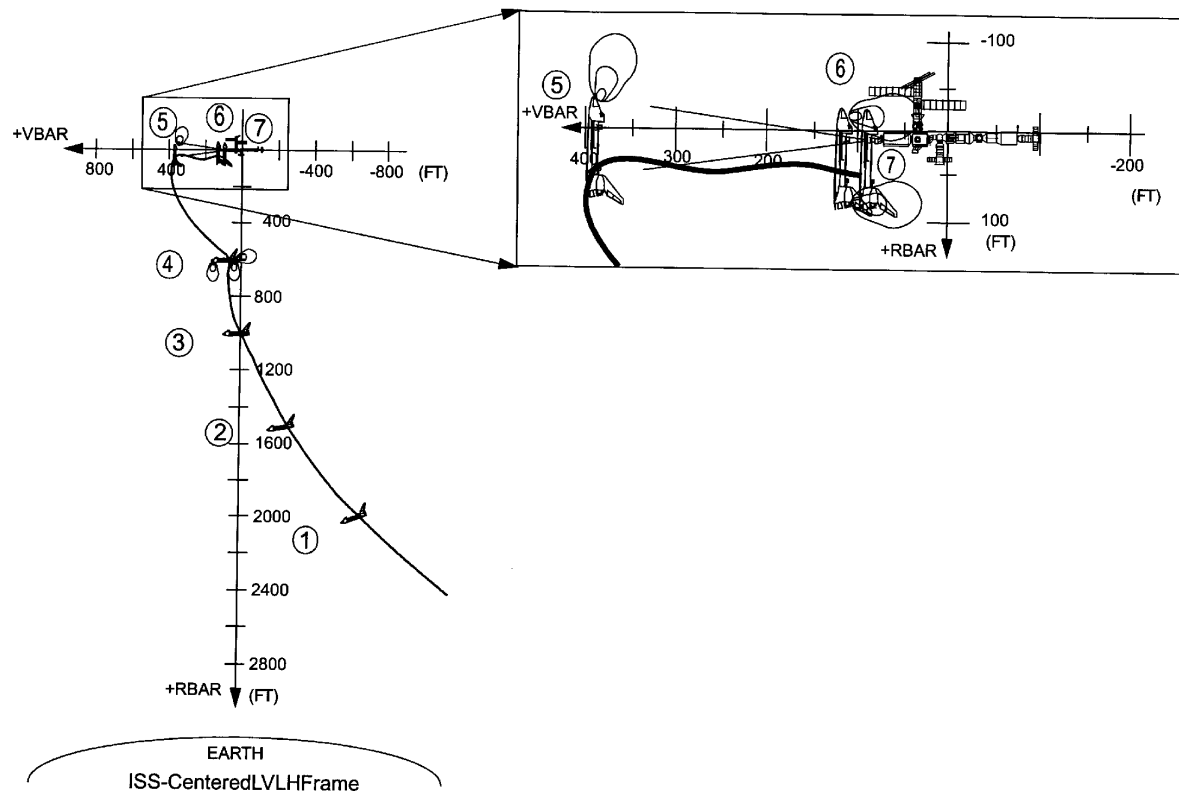
6A Initial Configuration
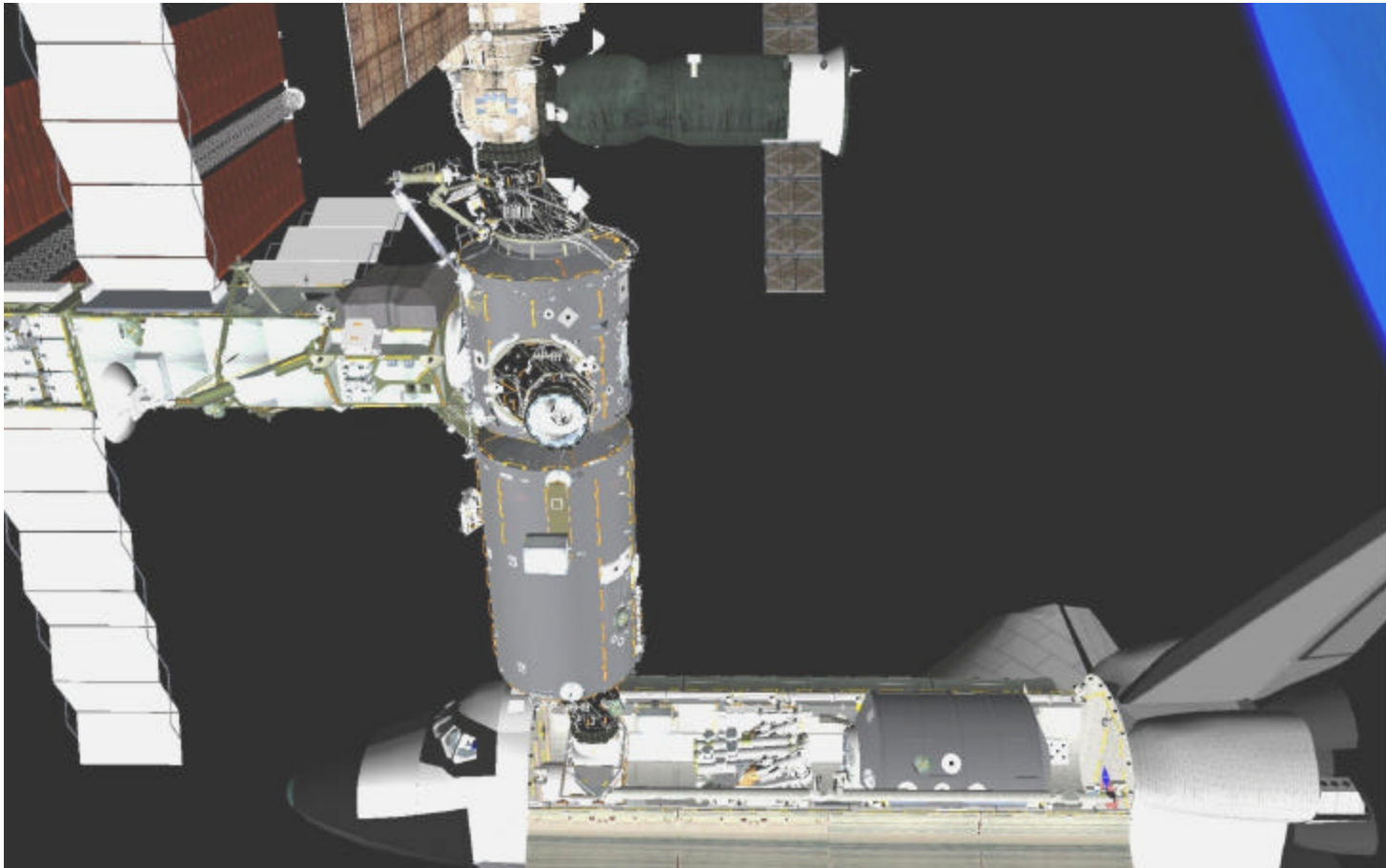
6A Mission Overview

- **FD4**
  - **SRMS transfer of SLP to Lab Cradle Assembly**
  - **EVA 1**
    - **Connect power to SLP via J300 Umbilical, activate keep-alive power**
    - **Transfer ISS UHF antenna from SLP to Lab**
    - **Remove restraints (Superbolts) from SSRMS**
    - **Initial boom raise (manual)**
    - **Unfold boom segments and secure in onorbit configuration**

  - **Raise SSRMS booms (Robotic)**
    - **When SSRMS reaches operational temp, use shoulder joint to raise booms**
  - **Orbiter 14.7 psi Repress (During EVA)**
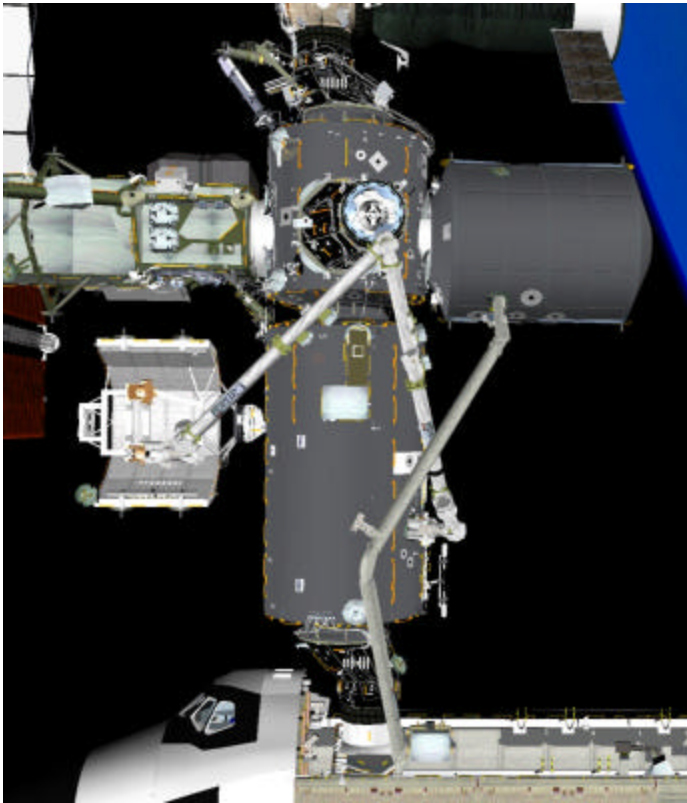
6A after EVA 1/SSRMS Transfer
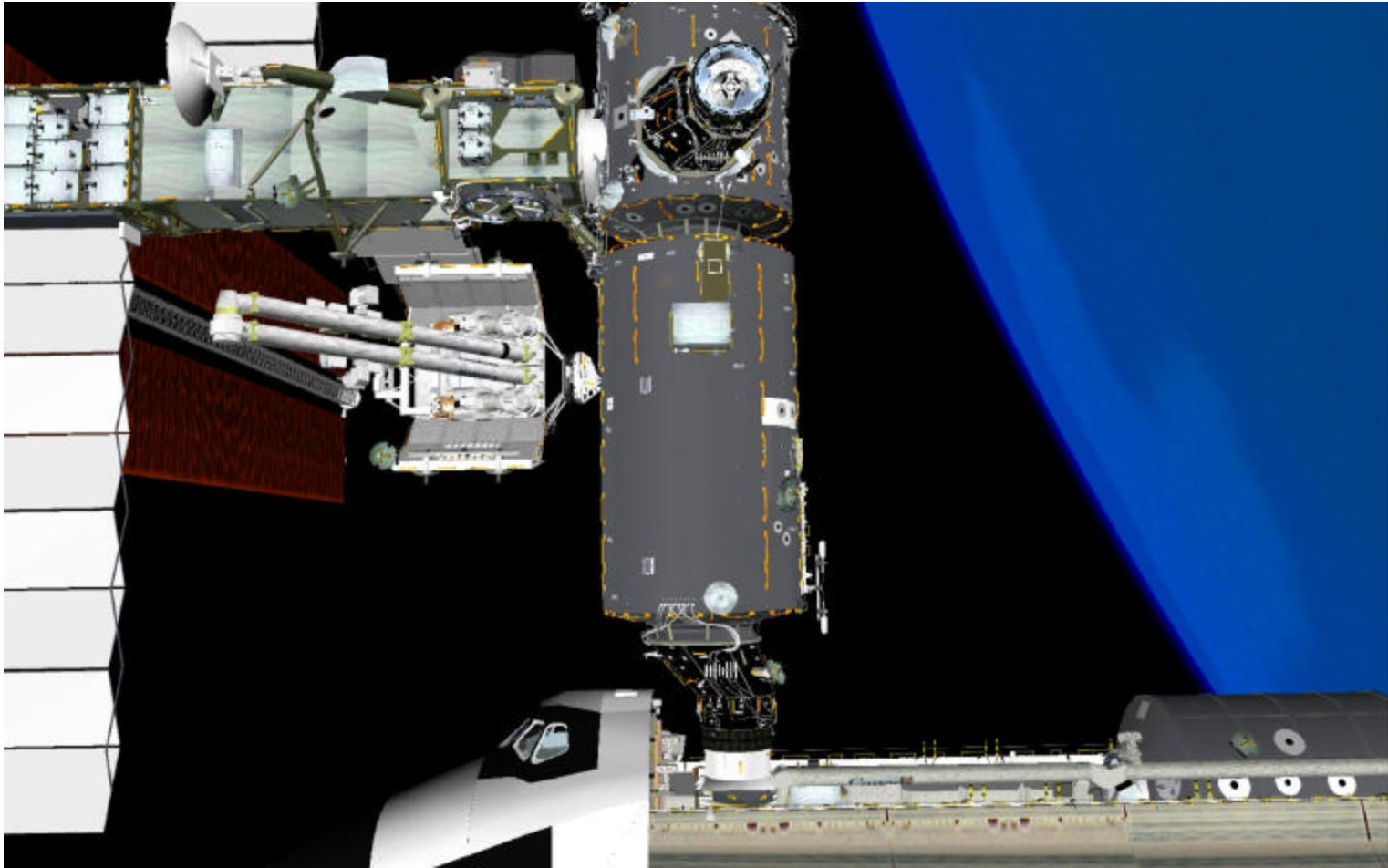
6A Mission Overview

- **FD5**
  - **Open Hatches (First full ingress this mission)**
  - **SSRMS Initial checkout (Joint tests), Lab PDGF Grapple**
  - **Install MPLM on Node Nadir using SRMS**
  - **ISS crew performs MPLM vestibule outfitting/MPLM activation**
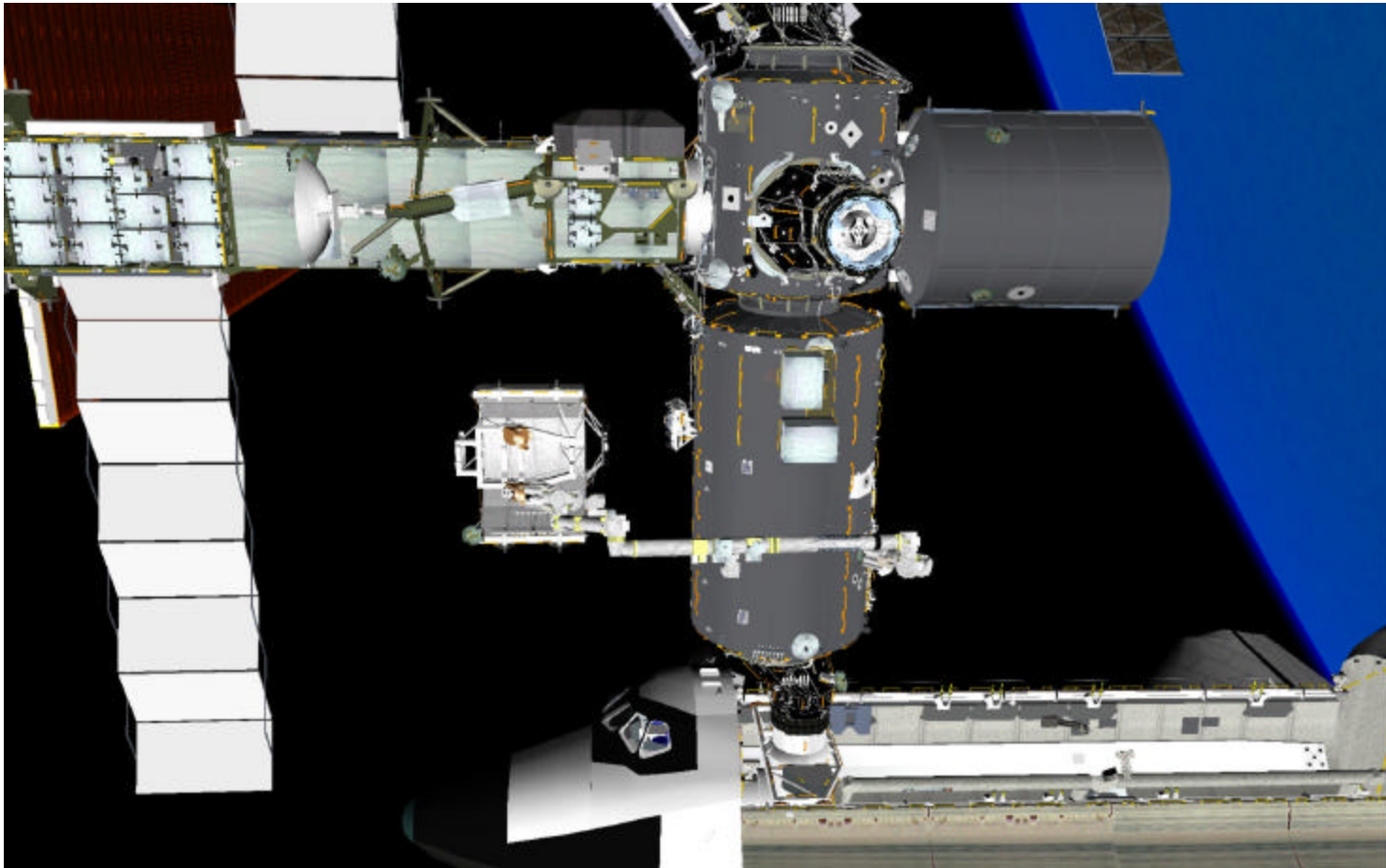 - **Close hatches, 10.2 depress**

6A After MPLM Transfer

6A Mission Overview

- **FD6**
  - **ISS crew performs rack transfers from MPLM**
  - **Shuttle crew EVA #2**
    - **J400 Power reconfig to power PDGF on Lab**
    - **Remove starboard Early Comm antenna from Node, VSC from SLP**
    - **Transfer DCSU to External Stowage Platform (ESP) on Lab**
 - **Repress to 14.7, open hatches**

6A after EVA 2

6A Mission Overview

- **FD7**
  - **SSRMS 'Loaded Checkout' with SLP**
  - **Handoff SLP to SRMS, berth in Shuttle PLB**
  - **Powered payload transfers**
  - **MPLM Transfers**

- **FD8**
  - **EVA 3 if required; otherwise – transfers, Additional SSRMs Checks**
  - **SSRMS Airlock Installation Dry Run**

- **FD9**
  - **MPLM Vestibule Deoutfitting, depress, leak checks**
  - **SSRMS Unloaded Dynamic Checkout**
  - **MPLM stow in Orbiter Payload Bay**
  - **Crew conference**

6A Mission Overview

- **FD10**
  - **Close Hatches**
  - **Undock from PMA2, Flyaround (ICBC Filming), Separate**
  - **Cabin Stow**

- **FD11**
  - **FCS C/O, RCS Hot-fire, Cabin Stow**
  - **Off duty for second half of day**

- **FD12**
  - **D/O Prep**
  - **Landing 10/18:54**

Undock/Flyaround Sequence

Dashed lines represent IMAX field of view (100mm lens)
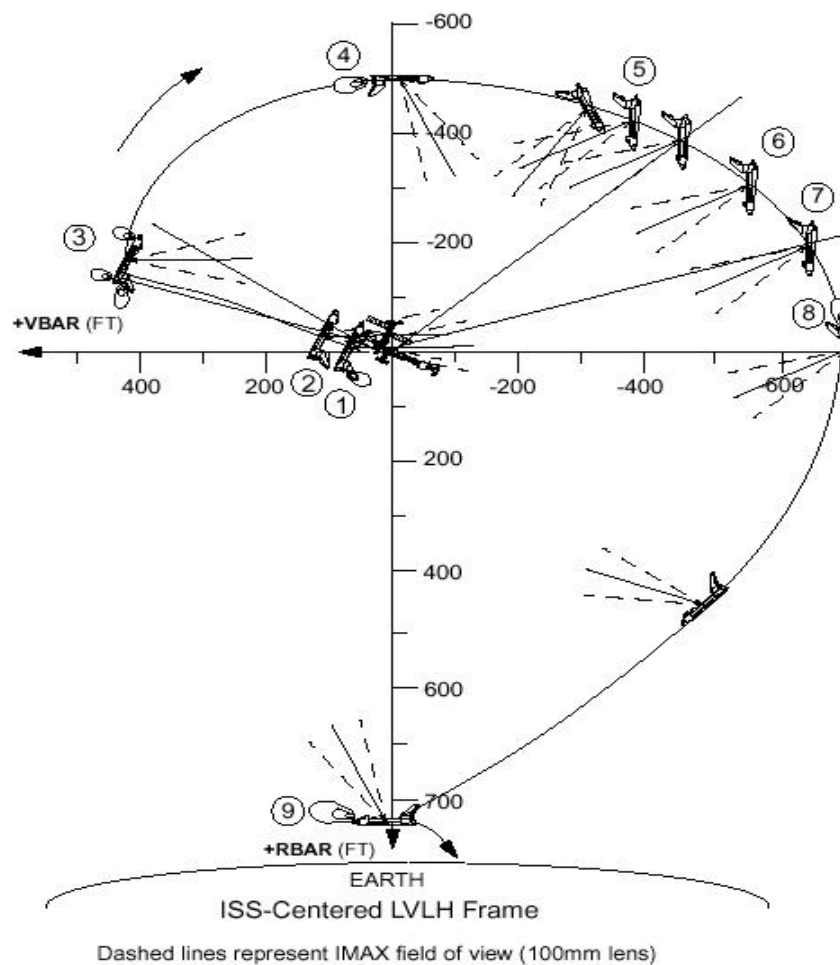
Soyuz/STS-100 Launch Conflict Issues

Considerations Affecting the Choice

Of STS-100 Launch Date

Current Plan

- The baseline plan for these launches:
  - 6A Shuttle launches on 4/19
  - 2Soyuz begins fueling and final irreversible launch processing after confirmation of 6A launch on 4/19
  - 6A Shuttle nominal undock on 4/28
  - 2Soyuz launches on 4/28 and docks to ISS on 4/30
- Considerations
  - Accommodates Russian request to avoid May Day holidays
  - If 6A undocks 4/28, crew will only have one day off vice 2 that are baselined between shuttle undocking and Soyuz docking
  - Regardless of the undocking day, the last crew off-duty time will have been half day on April 14 and half day on April 15 (i.e., will have worked 13-14 days continuous)

Shuttle Launch Considerations

- Shuttle Launch Constraints
  - Range unavailable May 11-19
  - Beta angle cutout May 18 – June 7
  - No Arrivals/Departures during shuttle docked period
  - ISS Food depletion estimated June 1
    - Shuttle or Progress can resupply
    - Progress launch on May 20 is first flight of upgraded booster
- Soyuz Launch Constraints
  - New Soyuz (S2) Must Launch By May 11
    - Onorbit Soyuz 1 reaches 200 day Life Limit
  - S2 Arrival requires P3 undock, S1 flyaround to clear port
    - 2-day timeline impact
- Protecting two days between shuttle undocking and Soyuz docking is prudent

Mission Impacts of Options

- If STS-100 Launches before Soyuz 2:
  - PRO:
    - Maximizes Shuttle launch opportunities
    - Maximizes margin for ISS food resupply
    - Supported by existing flight products (flight plan, thermal analysis, etc.)
  - CON
    - Shuttle must stand down for Soyuz if not launched before Soyuz mandatory launch date
    - Aggressive ISS crew schedule – no rest between 6A and 2 Soyuz
    - Reboost option constrained by Soyuz phasing requirements, however, reboost can still be performed

Mission Impacts of Options

- If Soyuz launches before STS-100
  - PRO
    - Minimizes impacts to ISS crew for 6A stage operations
      - Soyuz changeout and visiting crew activities 'out of the way' before 6A cargo and robotics operations
  - CON
    - Significant mission rework
      - Shuttle and ISS crew sleep cycles mismatched by ~ 6 hours due to shuttle planar launch window shift
      - May be able to minimize impact with descending landing opportunities
      - Must work around range availability and Beta constraints
    - Reduces overall number of shuttle launch attempts

Launch Option 1

- Current NASA Plan:
  - Protect Shuttle launch attempts from April 19 until May 1
  - If no launch by May 1, stand down for Soyuz launch on 10 May
    - Earliest Soyuz date if launch processing cannot start until shuttle launch/stand down decision
  - Soyuz slips day for day based on shuttle launch, or targets for May 10 a priori
    - Day for day slip minimizes time between STS-100 undock and S2 arrival, but maximizes Soyuz launch opportunity
    - May 10 target minimizes margin for onorbit 1Soyuz lifetime, but provides best possible ISS crew schedule

Launch Option 2

- Rosaviakosmos Plan
  - Soyuz 2 launch April 28, independent of shuttle launch slip
    - Protects Russian holidays May 1,2 and 9.
    - Accommodates shuttle launch only on April 19. April 20 launch would require mission duration constraints.
      - NASA position is that Soyuz docking with shuttle present is not allowed
        - Clearance concerns for FGB nadir approach
        - Loads assessment required for SM aft dockings
  - If shuttle does not launch on April 19, next window is post Soyuz 1 sep, May 6, until range cutout, May 10.
    - Assumes no Soyuz delay, or shuttle takes priority for May 6 date
    - Next opportunity is June 8

Summary

- The basic decision point is whether to launch STS-100 before the 2Soyuz or after
  - 'Before' maximizes shuttle launch opportunities (12) and resupply consumables margin, but complicates 6A stage crew ops
  - 'After' results in reduced shuttle launch opportunities (5) but simplifies stage operations
- If Soyuz does not move from April 28, need to decide whether to attempt April 19 or stand down to May 6
  - If no launch on April 19, still have the chance to make May 6-10
  - If no launch in May, slip until June 8